SENSE OF REALITY TROUGH MODELING

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Swan, Turner, Yoon & Muller (2007)

When presented with problems set in some real world context, students formulate questions about the context and think about the usefulness of their mathematical knowledge to investigate the questions. They are immediately encouraged to connect their mathematical knowledge with the external context. Mathematical thinking is promoted, and reasoning skills are exercised, as students seek to make those connections. (p. 281)

Swan, Turner, Yoon & Muller (2007)

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Brief description of modeling in Colombian educational regulations

"it is necessary to relate the contents of learning to students' daily life, present them in the context of problem situations and exchange of points of view".

The modeling *allows students to observe, reflect, discuss, explain, predict and revise, and thus build mathematical concepts based on meaning. Therefore, it is considered that all students need to experiment mathematization processes that lead them to discover, create and establish models at all levels*

National Education Ministry -MEN (1998)

The Research

The context:

This project counted on the participation of four teachers that worked in various levels of public schools. The four teachers hold bachelor degrees in Mathematics and one of them holds an specialization degree in mathematics teaching. They worked in a Colombian sub region 3.5 hours away by road from Medellín, a main city of Colombia country.

Instruments

- Observations on the classroom (from April to June in 2008 year)
- Studies of episodes. (1 cartoon, 1 document MEN (1998), 3 problem modeling created by other teacher)
- Questionnaires (one)
- Interviews (one)

The Research

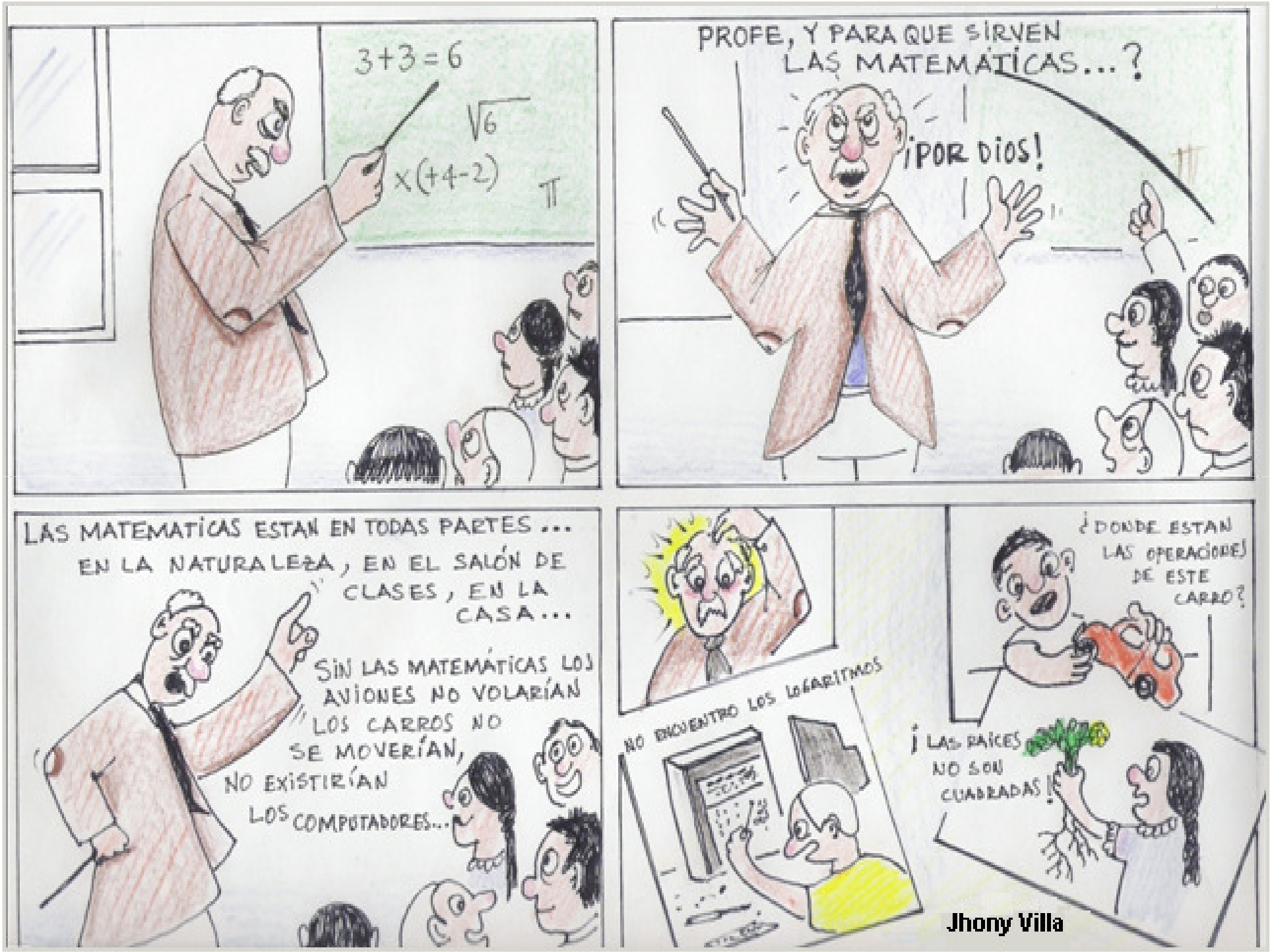
The Case Study:

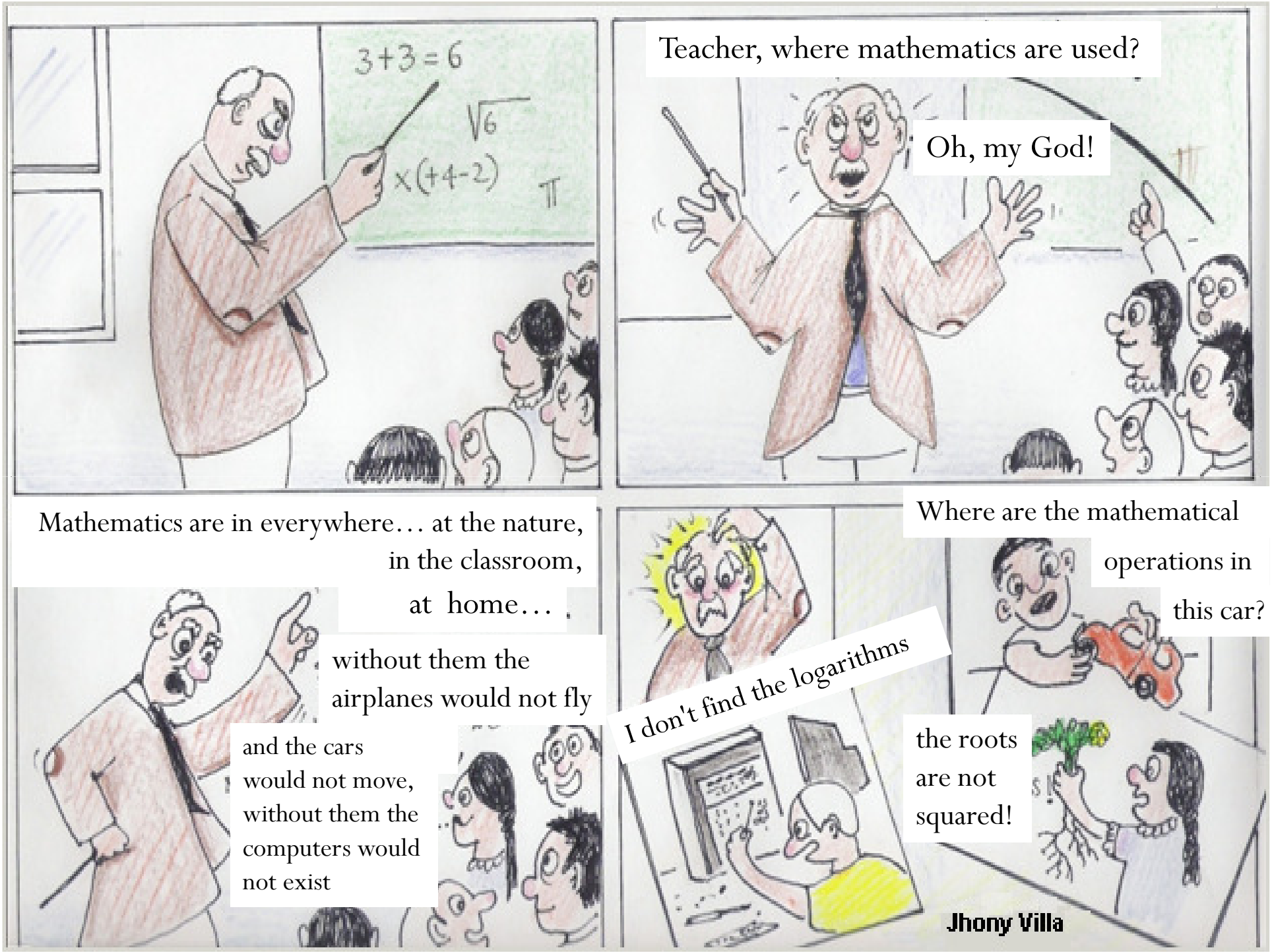
A case study is an empirical inquiry that investigates a contemporary phenomenon within its real existence context, when the boundaries between the phenomenon and the context are not clearly evident.

Yin (2003)

Episode Nº 1

The cartoon


3+3=6
√6
x(+4-2)
π
PROFE, Y PARA QUE SIRVEN LAS MATEMÁTICAS...?
¡POR DIOS!
LAS MATEMATICAS ESTAN EN TODAS PARTES... EN LA NATURALEZA, EN EL SALÓN DE CLASES, EN LA CASA...
SIN LAS MATEMÁTICAS LOS AVIONES NO VOLARÍAN LOS CARROS NO SE MOVERÍAN, NO EXISTIRÍAN LOS COMPUTADORES...
NO ENCUENTRO LOS LOGARITMOS
¿DONDE ESTAN LAS OPERACIONES DE ESTE CARRO?
¡LAS RAICES NO SON CUADRADAS!
Jhony Villa


3+3=6
√6
x(+4-2)
π
Teacher, where mathematics are used?
Oh, my God!
Mathematics are in everywhere… at the nature, in the classroom, at home… .
without them the airplanes would not fly
and the cars would not move, without them the computers would not exist
I don't find the logarithms
Where are the mathematical operations in this car?
the roots are not squared!
Jhony Villa

The results

Episode Nº 2

A family of four (4) people has invited three (3) friends to have dinner at home. How many places will be set at the table?

MEN (1998, p.78)

Alberto Said:

I would think that it is not real, it may not happen [. . .] *my kids would say "we don't have food for one, let alone to invite three" What is real, the language used? what is common in reality is what I live and what may actually happen* [. . .] *for me that is not real, that will never happen. For me a real situation is not something that exists per se, but something that exist in the ambit of the language he knows, he sees, he has touched, he can work with, but not those real situations that are real, but out of context, or concealed and actually all the problems posed are of the same kind: cross a river, throw a liana, estimate an angle, measure the distance, anyway* [. . .]. *Do we use real situations to solve problems?, I do not think. They are rather common situations and of the language; it wouldn't justify its usefulness either* [the use of the mathematics]

Alberto Said:

I have been doing this for 13 years [the teaching], *and many times I have found that I have never been able to satisfy, ¡me! I have never found an answer. I give the answer that I think many of us would give, but I have not been satisfied with it I haven't been able to. That, is the mathematics good for everything? I have not found that it has actually been useful for everything.*

Alberto Said:

I am a teacher. I am a bachelor of mathematics and when I work with my ninth grade students I tell them "you study it because you have to study it" [topics in mathematics], *¡Me!, ¡Me! I feel in the middle of that kind of inability, I do not find ways of application for everything. There are some things that I can say. Yeah, that trigonometry, the law of sine and cosine. Yeah, that it's topography … it can be visualized. Let's build something and we can see* [find]; *the angle can be seen. Yeah, geometry … the kite, the angle, it can be seen. There are few things that I can show my kids, but all the content in the curricular guidelines* [MEN, 1998] *and nowadays Curricular Standards* [MEN, 2006] *that fills our class plan ¡it is enormous!*

Alberto Said:

[…] *and I find three or four students, I know them!, that they enjoy seeing me to do little things* [procedures and algorithms] *but a great majority ask: why? when am I going to use it?* [mathematics] *that is why I have to get involved and find a relationship because the word that appears there* ["mathematics are in nature", in the cartoon represented],… *ancient mathematicians, Pythagorean, found such relationship , lived it and based on that built, which means that* [mathematics] *actually is in nature, the beauty of numbers is there; I have not found it, I know mathematics are beautiful, but I have not been able to trace it out or take it to my kids and it is there where I find a fundamental reason of why the mathematics are a torture for most of the kids* […]

Alberto Said:

For me, I am that teacher there [in the cartoon], *I see it, and I take a piece of paper and show the geometric shape of tree leaves, how the population grows, and the exponential population growth.* [. . .] *I get up to here and my kids go to reality and nothing seems to show the relationship I pointed out to, but my way of showing it is not for being visualized by them.. I am convinced that the relationships are there [*in reality], *but when I bring it here* . . . [to the classroom] *the students say "the teacher did not teach me how to discover it".* [. . .] *the fact that the student can discover it by himself, uh!* . . ., *that's my greatest challenge.*

DISCUSSION

It is clear for Alberto, that the real situations considered in the classroom should go beyond a "making up" of concepts in an artificial context. The same way, many of the situations presented in textbooks intend to approach reality, but in most cases they are too simple, which does not allow the teacher nor the students to develop real inquiry processes in search for data, when determining and simplifying variables and regularities. Being this the order of ideas, it is important to consider that the role of modeling in the classroom is to permeate the view that the teachers have of their social and cultural environmental.

DISCUSSION

This depends, to a large degree, on the capacity teachers have to identify real contexts to approach it. So, for example, when identifying a company in the region as objective reality (there are offices, raw materials, people, it offers services, etc) it is necessary to consider the various ways individuals (students and teachers) have to approach such reality. In other words, such company is also *subjective reality* that involves several kinds of reality; which is, the teachers and students as well as the other people in the setting have several ways of interaction and therefore building up different kinds of meaning based on unique experiences.

DISCUSSION

Literature repeatedly values the importance of teacher reflection on what happens in the classroom and paying attention to students' needs as a condition implied in the transformation of practices within the classroom. However, in the case of Alberto, it is possible to establish such reflection as a necessary condition, but from the perspective of modeling and applications as a tool to allow an approach to social reality, the condition is not enough.

DISCUSSION

Therefore, we consider the need to maximize the development of a ***"Sense of reality"***, that we understand as *sensitivity that a teacher should have towards reality, that also includes intuition and the capacity to detect situations and opportunities in the socio-cultural context towards which students' knowledge can be geared. Such sense includes a good dose of imagination and creativity.* The *sense of reality*, more than a rational component of teacher's knowledge, is a subjective component that metaphorically acts as a magnifying glass with which the teacher observes *objective reality* and facilitates the (re)significance of such reality as of a mathematical modeling process.

DISCUSSION

Based on the above, we consider that when facing real situations in the socio-cultural context of the classroom, modeling becomes a tool that allows the (re)significance of such contexts. But in addition to this, we think that modeling must advance towards the notion of *practice that includes the (re)elaboration and interpretation of models already developed*. Therefore, the *problems* must be assumed as *real context problems;* understanding *real context as* daily, social, cultural, consumption and other sciences contexts, where students are required to identify and manipulate data, simplify and make abstraction of amounts and variables in order to build a model to solve the problem.

DISCUSSION

From the perspective above, *sense of reality* combined with *reflection about practice and knowledge and students' needs* must make possible the appraisal of *school mathematic reality* (i.e invent, distorted, manipulated, … see: Alsina, 2007) and promote the implementation of other realities closer to daily life in the students' socio-cultural context. This way, *"close or tangible reality"* can be privileged in the first instance, since being part of the students' contexts, transcends the idea of *possible contexts* to set up real problems that make it possible for students to have a critical perspective of some social demands (such as consumption).

DISCUSSION

This is a way to comply with one of the social duties of modeling in school mathematics, since through a "*sense of reality*", modeling not only is in charge of the interpretation and solution of real life problems, but also promotes its transformation (subjective reality) by (re)signifying such (objective) reality.

CONCLUSIONS

This case study shows that even though there are teachers who have a strong positive belief about classroom work and solid favorable attitude towards change, (Agudelo-Valderrama et al., 2007), it is still necessary to develop a *sense of reality* to make possible for the teacher to establish relationships between the socio-cultural context and school mathematics. Therefore, "reflecting about what happens in the classroom and paying attention to students' needs" are necessary conditions within the educational process of some teachers; however, in the case of modeling and applications as a maximum component of the socio-cultural context, the conditions are not enough

CONCLUSIONS

This case study highlights the important of reflection about *reality* as a component close to the students' socio-cultural context; likewise, it makes evident the importance of a concept of reality that transcends the various school realities (i.e invent, distorted, manipulated, … see: Alsina, 2007) to offer students better approaches to establish relationships between mathematics and the real world.

CONCLUSIONS

This case study created certain implications for teaching undergraduate and graduate programs, since, based on Alberto's case, the need for reflection about the socio-cultural context in order to develop a *sense of reality*. It demands serious research processes that should inquire into various aspects, among them:

- The ways how teachers interpret reality.
- The ways how teachers think that a situation "is in harmony" with the textbook.
- The way how teachers considers that a situation "accommodates" or adjusts to school reality.
- The level of comfort and appropriation that the teachers have about the socio-cultural context.
- The "rationality" that teachers assign the phenomenon related to the concept to be built.
- The level of "training" that teachers have regarding the modeling process.

CONCLUSIONS

We consider that these criteria may be judged as "little rational" and affect decision making and appropriation of a situation or phenomenon in the socio-cultural context. Finally, we consider that just arising a *"sense of reality"* does not transform conditions in the classroom, but without such a sense, there is a risk of remaining in the knowledge transmission model, which does not know about the tools offered by the socio-cultural context to build mathematical knowledge at school.

New Questions:

- Are there relationships between *sense of reality* and mathematical teacher knowledge?
- How can *sense of reality* be developed?
- What is the relationships between *sense of reality* and competences in mathematical modeling?

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THANK YOU!

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